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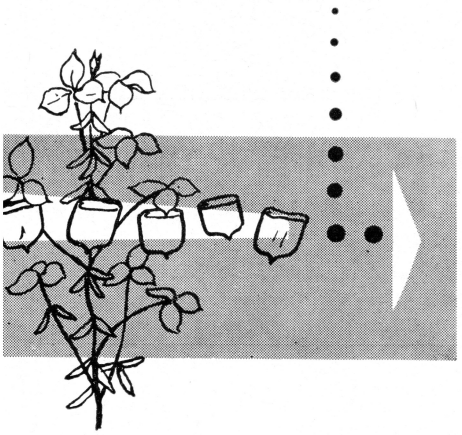
John Pesek
Iowa State College

E. R. Duncan
Iowa State College

W. D. Shrader
Iowa State College



Soil and Crop Management Practices for Iowa

Part II: Corn and Soybeans

Soil and crop management practices for oats and meadow appeared in the January issue of *Iowa Farm Science*. This second section by the same authors deals with soil and crop management practices for corn and soybeans.

by John Pesek, E. R. Duncan and W. D. Shrader

IOWA CROPS AND SOILS can be managed differently with about the same degree of success. Even with similar conditions, different farm operators use different management practices.

Since a farm operator can't specifically predict weather, prices or even his costs, he must rely on "probabilities." The results of work by research agronomists at Iowa State College can help you select the practices which give you the greatest probability of success in crop enterprises.

Though farm operators today have much greater latitude in crop and soil management than in the past, management itself is more exacting now. Goals are higher. Good farmers 20 years ago, for example, thought 60 bushels per acre was a good yield of corn. Now the same men expect 90-100 bushels per acre or more.

In our first section (Part I: Oats and Meadow) in the January issue of IOWA FARM SCIENCE, we listed the principles of soil and crop management. Included were such things as soil and water conservation; drainage; weed and insect control; liming, fertilizing and manuring; crop rotations; choosing proper varieties; getting field operations done on time; and adjusting production practices and even crops to fit expected weather.

You can't change the weather. But you can manage crops, to some degree, so as to evade some of the bad effects of adverse conditions.

We know that subsoil moisture to a depth of 5 feet usually is essential for high corn and meadow yields—assuming a normal rainfall distribution during the crop year.

When there's little moisture for crops below 3 feet in the soil, the odds are against high yields of corn and hay. Oat yields aren't affected the same way. Oats don't depend so heavily on subsoil moisture. Silt loams tend to hold more water available to plants per foot of depth than does either clay or sand. You can take such factors as these into account in planning and carrying out your operations.

Corn . . .

The highest average corn yield on record for Iowa was recorded in 1952. The 1955 yield was among the lowest. But in both years, some fields yielded above the average in their locality.

The above-average yields came on fields where: (1) fertility was high or where fertilizers had been used, (2) stands were adjusted to fit soil fertility and moisture conditions, (3) seedbeds were well prepared without excessive operations, (4) weeds and insects were controlled, (5) water was conserved either naturally or by special practices and (6) planting and other operations were correctly timed.

This early in the year, soil conditions over much of the state point to a situation favoring relatively low rather than very high yields in 1956.

Fertility: Corn draws heavily on plant nutrient supplies in the soil. A highly fertile soil has an adequate supply of plant nutrients in a form ready for crops to use.

Remember, for example, that an 80-bushel corn crop needs more than twice as much available nutrients as a 40-bushel crop. These extra nutrients are needed to take care of the peak demands of the corn crop during its period of rapid growth and development. When the soil can't supply enough nu-

JOHN PESEK, E. R. DUNCAN and W. D. SHRADER are associate professors of agronomy.

trients, the extra nutrients have to come from another source. Common sources of added nutrients in the past have been barnyard manure and inoculated legumes. More recently commercial fertilizers have come into the picture in Iowa in a big way.

In Iowa, soil tests give a reliable indication of nitrogen, phosphate, potash and lime needs for a particular field. The fertilizer recommendation accompanying the soil test report is one that will give maximum profit from each acre fertilized under average management and weather conditions. For those who want them, lower recommendations for operators with limited capital are available from your county extension director. Higher recommendations for superior operators with sufficient capital are available from the same source.

Lack of nitrogen probably limits Iowa corn yields more than the shortage of any other single plant nutrient. You can supply nitrogen through inoculated legumes, manure or commercial fertilizer. Good to excellent legume stands usually supply enough nitrogen for corn in the immediate year following. Corn following poor stands of legumes can benefit by applications of up to 40 pounds per acre.

The greatest need for commercial nitrogen fertilizer is on corn 2 or more years after a legume meadow. Second-year corn growing on some of the dark-colored soils high in organic matter usually needs between 40 and 70 pounds of nitrogen per acre. Second-year corn on the lighter-colored or eroded soils usually needs from 60 to 90 pounds or more of nitrogen per acre for optimum yields.

Hill or row applications containing 5 to 10 pounds per acre of nitrogen and 15 to 30 pounds of phosphate usually are profitable in Iowa. In addition, 10 to 20 pounds of potash per acre usually will pay in north-central, northeastern and southern Iowa.

Where nitrogen, phosphate and potash are needed, the equivalent of 100 pounds of 5-20-20 or 5-20-10 per acre is recommended. If only nitrogen and phosphate are needed, we suggest 80 to 85 pounds of 6-24-0 or the equivalent.

It's usually not advisable to exceed these amounts of fertilizer in the row. If larger amounts are needed, plow under additional phosphate or plow under, disk in, inject or side-dress additional nitrogen if it's needed.

If you apply row or hill fertilizers, you can use fertilizer-insecticide mixtures to control the corn rootworm. Such fertilizer-insecticide mixtures usually are used on corn 2 or more years after a meadow.

Manure is an excellent source of plant nutrients. Conserve it and use it efficiently. You can make the most efficient use of manure by making the best use of its nitrogen content. This means first choice for applying manure should be on second- or third-year corn. The second choice would be corn following oats or soybeans. Applying manure on growing legume meadows or before plowing them under, thus, isn't the most efficient use.

Good Stand of Corn? The most desirable stand of corn or plant population per acre varies with the fertility level and moisture-holding capacity of the soil. The moisture reserve in the soil at planting time also is an important factor in any given year. With favorable moisture and fertility, stands of from 16,000 to 18,000 plants per acre seem best (see table 1).

Under average weather conditions and on drained soils, you stand a much better chance of making high corn yields in those years when your subsoil is filled to capacity with all of the water it will hold at the beginning of the season. Results on the Bredensteiner farm (table 2) illustrate that it's possible to make good corn yields in seasons when the rainfall is far below normal—if the subsoil is full of moisture at corn planting time.

When the subsoil is very low in moisture at planting time and when rainfall is light, your chances of getting high corn yields are lowest. This was the situation in Wayne County (see table 2) in 1954.

Though there have been some setbacks from high stands in the last year or two, it's still generally true that the best corn yields are made with higher-than-average stands. It's a good idea, however, to be able to recognize situations where unusually high plant populations are undesirable and to act accordingly. It's equally important to realize when the chances of success with higher stands are good.

When grown under similar conditions, early maturing varieties make their best yields with stands of 3,000 to 4,000 *more* plants per acre than the full-season varieties. It's also advisable to plant higher stands on highly fertile fields or

TABLE 1. How Yield of Corn May Be Expected to Vary with Stand and Fertility Levels.

Plants per acre	Low to medium fertility soil		High fertility soil	
	Early variety	Adapted variety	Early variety	Adapted variety
8,000	60	65	60	70
12,000	65	75	80	95
16,000	75	75	90	115
20,000	75	75	95	125

on fields where heavy fertilizer applications have been made.

In many cases poor results from fertilizers have come about through a lack of adequate stand levels. At the same time, results with high stands of corn have often been disappointing because of low soil fertility or a failure to fertilize heavily enough with commercial fertilizers. As a guide: If your corn ears average over ½ pound each, your stand probably is too low.

Soil, Water Conservation: To maintain satisfactory corn yields over time, we'll have to control erosion. Erosion in any one year may reduce stand and result in the loss of applied and native fertility through the loss of topsoil from a field. It doesn't make sense to willingly permit loss of this fertile topsoil from our sloping land, which is already among the least fertile on the farm.

Both soil and water losses are effectively controlled by the use of practices such as terracing, contouring and strip-cropping. Preparing the seedbed on the contour on sloping soils is always a good practice. It slows down water runoff, and the cost of operating on the level tends to be less than for up-and-down-hill operations.

Fully as important, from the standpoint of yields, as soil loss in recent years is the saving of the rainfall which falls on sloping land. An extra 2 or 3 inches you can save in the soil can easily make a large difference in corn yields.

The practices most commonly used in water conservation are also highly effective in soil conservation, too. Recent experimental work has shown that the "bottleneck" of moisture and soil conservation usually is in the surface soil. This must be open and porous for rainfall to penetrate down into the soil. Incorporating crop residues into the surface—a light coating of manure immediately following planting, for example—has been an effective method of keeping the surface soil open for rainfall penetration.

It's commonly known that land in corn following a sod crop erodes less than land in corn or other intertilled crops following corn or small grain. It's less well known—but equally true—that a good stand of vigorously growing corn allows less erosion than a thin stand of nutrient-deficient corn. Corn with a cover crop or grass between the rows also erodes less than a clean-tilled field of corn on sloping land.

Weed, Insect Control: Controlling weeds and insects aren't, strictly speaking, yield-increasing practices. Controlling both weeds and insects, however, does let the corn crop make maximum use of moisture and fertility. This eventually is expressed in terms of yields superior to those that might be obtained without control of insects and weeds.

TABLE 2. Yields of Adapted Corn Varieties in Bushels per Acre as Affected by Stand and Season on Well Fertilized Soils.

Farm	Year	Stalks per acre			
		8,000	12,000	16,000	20,000
Jens Anderson O'Brien County	1952[1]	92 bu.	109 bu.	120 bu.	125 bu.
Duane Bredensteiner Fremont County	1953[2]	80	90	97	96
Seymour-Shelby Expt. Farm Wayne County	1953[3]	58	62	60	56
Seymour-Shelby Expt. Farm Wayne County	1954[4]	18	12	8	4

[1]Good subsoil moisture supply; excellent rainfall during growing season.
[2]Good subsoil moisture supply; two-thirds of normal rainfall between corn planting and harvest.
[3]Probably good subsoil moisture supply; 7.9 inches rainfall May 1 to Sept. 1; July 1.0 degree above normal temperature.
[4]Dry subsoil; only 7.2 inches rainfall from May 1 until Aug. 8, at which time crop had been lost; July 3.6 degrees above normal temperature.

There are many soil insects which hinder development of the corn plant. Corn rootworm is one of the best known of these insects. It tends to be a greater problem in second and later years of corn than it does in corn following a legume-grass sod.

We mentioned earlier that you can accomplish corn rootworm control by using fertilizer-insecticide mixtures provided you apply fertilizer in the hill or row. Other ways of applying soil insecticides are (1) spraying into the open furrows during planting and (2) spraying on the soil and disking immediately during seedbed preparation. This last method is well adapted to the control of other insects which attack corn roots on land which has come immediately from sod. (See "Soil Insecticides—Crop Insurance" in the March 1955 issue of IOWA FARM SCIENCE or Farm Science reprint FS-597.)

The European corn borer is an ever-present menace to high yields. To allow the corn plant to develop normally, most farmers find it advisable to spray at least for the first brood of corn borers.

Weed control is important mainly from the standpoint of the competition the weeds offer to the corn crop. Weeds compete with the crop for both moisture and nutrients. So it's important to keep them under control.

Heat and Drouth: A check of the weather records in Iowa shows that it's seldom possible to avoid excessive heat and drouth during the critical stage of tasseling and silking by planting corn late. The years when late planting can help are the *exception* rather than the rule.

Under Iowa conditions, on the other hand, there are some years when early-planted or early-maturing varieties of corn may be pollinated before severe hot weather and dry winds strike. This isn't true every year, but it is true more often than not. Another disadvantage of late-planted corn or of

late-maturing varieties is the fact that corn which is pollinated after Aug. 10 must stand the risk of an early fall freeze. Soft corn may be the result.

It's possible you might want to plant both early-maturing and late-maturing varieties on the basis that one or the other might escape the more serious hot weather. If you do this, plant the early maturing corn *early* and the late-maturing corn *later*—if you want to spread the pollination period. If you should plant the late corn earliest and the early corn last, you face the possibility that both of the hybrids may come into pollination at the same time.

You can follow this early and late planting scheme in seasons when you can get into the field early and plant on time. But it's still necessary to contend with possible early frost in the fall. Thus, if the season is late or if you aren't able to plant your corn on time, it may be more important to try and avoid an early frost than to try evading the hot weather of summer. In this case, the longer-maturing variety should be planted first, and the short-season variety planted last.

Many, if not all, short-season varieties produce less stover per acre and less stover per bushel than full-season varieties. The short-season varieties probably require less water because of this. The short-season variety, Iowa 4297, for example, has outyielded the full-season variety, AES 801, during the dry years of 1953-55 in Wayne County. Both varieties were planted at the same time and at the same stand and fertility levels. Thus, it seems possible to use short - season varieties to stretch short moisture supplies.

Prepare Good Seedbed: Preparing a good seedbed is *always* important in getting ready for corn. But when the spring is dry, don't work the soil excessively. Additional moisture is lost from the surface soil each time you go over the field with a separate operation. This moisture is lost through evaporation, and you may end up planting your corn in a dry soil. The result may be slow germination.

Some farmers have gotten around the series of operations needed to prepare a good seedbed by pulling several implements in tandem. This way, they've cut down the number of times the soil is turned over—and thereby have reduced evaporation losses.

Certainly it's important to prepare a good seedbed for corn. But take care that the number of operations isn't excessive under *dry* spring conditions.

Remember that corn should be cultivated, not plowed. There's little reason for cultivation beyond that of controlling weeds. If there are no weeds, there's no particular reason for cultivating corn.

After your first cultivation, it's particularly important to adjust the front shovels of the cultivator in such a way that they don't prune the roots of the corn plant. Pruning roots through deep and close cultivation means fewer roots to take up what moisture there is in the soil. There are also fewer roots to take up nutrients. Close-cultivated corn in a dry season may show a greater degree of drouth and low-fertility damage than corn with more careful cultivation.

Soybeans . . .

Soybeans give highest yields on limed, fertile soils. But under average conditions, soybeans give little response to direct fertilizer applications. When a soil test shows *very low* phosphorus or potash availability, however, the use of 200 to 300 pounds per acre of 0-20-20 or 0-20-10 is beneficial.

You can grow soybeans on low-fertility, unlimed soils, but you can expect top yields only on the better soils. Like other legumes, soybeans grow best on non-acid or limed soils. The nodule-forming bacteria function most efficiently under these conditions.

Soybeans may yellow because of iron deficiency on high-lime soils in northern Iowa. Spraying the plants with 10 pounds of ferrous sulfate in 50 gallons of water per acre has given good results. The operation can be repeated in a week to 10 days if the iron-deficiency symptoms continue.

Soybeans don't "hurt the soil" for the following crop *if* you control erosion. While corn following a legume meadow usually yields more than corn following corn, corn following soybeans also yields more than corn following corn. Where corn yields have been carefully compared in the same fields, it has been found that corn yields are 8 to 10 bushels higher following soybeans than following corn.

Yields of small grains, too, are higher following soybeans than following corn. The value of the corn increase, however, is usually greater than that for small grains. So ordinarily, it's more profitable to plant corn rather than small grains following soybeans.

Most soybeans in Iowa are planted in 40- or 42-inch rows at about 50 pounds of seed per acre. Actually, it's possible to boost yields by planting 20- or 21-inch rows with 75 pounds of seed per acre. But you may have a harder job of controlling weeds with the narrower row spacings. It's also necessary to start weed control earlier.

Should you use the narrow spacing, control weeds before planting by disking. Then use a rotary hoe before the beans come up if you find small weeds present. After the beans are up, keep weeds under control with two or three rapid cultivations with a rotary hoe before the beans get too large. If you can control the weeds, 20 percent or more higher yields may be made with the closer spacing.

For best soybean yields, plant adapted, recommended varieties early on well-limed soils. Keep the rows spaced close together. Always inoculate soybean seed and control both weeds and erosion.